SYSTEM AND METHOD OF XML BASED CONTENT FRAGMENTATION FOR RICH MEDIA STREAMING

FIELD OF THE INVENTION

[0001] The present invention relates generally to XML-based content fragmentation. In particular, the present invention relates to various methodologies for fragmenting XML-based content, while defining and describing the fragments to allow an intended recipient to use the XML-based content even when certain fragments are lost.

BACKGROUND OF THE INVENTION

[0002] This section is intended to provide a background or context to the invention that is recited in the claims. The description herein may include concepts that could be pursued, but are not necessarily ones that have been previously conceived or pursued. Therefore, unless otherwise indicated herein, what is described in this section is not prior art to the description and claims in this application and is not admitted to be prior art by inclusion in this section.

[0003] Rich media content generally refers to content that is graphically rich and contains compound or multiple media types, including graphics, text, video, and audio. Rich media encompasses a broad range of technologies and implementations, although it is often delivered through a single interface, where the rich media can dynamically change over time as well as respond to user interaction.

[0004] Streaming of rich media content is becoming more and more important for delivering visually rich content for real-time transport, especially within the Multimedia Broadcast/Multicast Service (MBMS) and Packet-Switched Streaming Service (PSS) architectures utilized in the 3rd Generation Partnership Project (3GPP). PSS provides a framework for Internet Protocol (IP) based streaming applications in 3rd generation (3G) networks, especially over point-to-point bearers. MBMS streaming services facilitate resource-efficient delivery of popular real-time content to multiple receivers in a 3G mobile environment. Instead of using different point-to-point (PtP) bearers to deliver the same content to different mobile devices, a single point-to-multipoint (PtM) bearer is used to deliver the same content to different mobile devices that are operating within a given cellular coverage area/service area. The streamed MBMS content may comprise video, audio, extensible markup language (XML) content such as Scalable Vector Graphics (SVG), timed-text and other supported media. Furthermore, the streamed content can be pre-recorded or generated from a live feed or source.

[0005] Until recently, applications for mobile devices have been text-based with limited interactivity. However, as more mobile devices are being equipped with color displays and more advanced graphics rendering libraries, consumers are beginning to demand a rich media experience from all of their wireless applications. A real-time rich media content streaming service is imperative for mobile devices, especially in the area of MBMS, PSS, and MMS services.

[0006] There are several existing systems for representing rich media, particularly in the web services domain, which include XML-based content. SVGT 1.2 is a language for describing two-dimensional graphics in XML. SVG allows for three types of graphics objects: (1) vector graphic shapes (e.g., paths consisting of straight lines and curves); (2) multimedia such as raster images, audio and video; and (3) text. SVG drawings can be interactive (using a DOM event model) and dynamic. Animations can be defined and triggered either declaratively (i.e., by embedding SVG animation elements in SVG content) or via scripting. Sophisticated applications of SVG are possible through the use of a supplemental scripting language which accesses the SVG Micro Document Object Model (uDOM), which provides complete access to all elements, attributes and properties. A rich set of event handlers can be assigned to any SVG graphical object. Because of its compatibility and leveraging of other Web standards such as Compound Documents Format (CDF), features such as scripting can be performed on extensible hypertext markup language (XHTML) and SVG elements simultaneously within the same Web page.

[0007] The Synchronized Multimedia Integration Language (SMIL) enables simple authoring of interactive audio-visual presentations. SMIL is typically used for rich media/multimedia presentations which integrate streaming audio and video with images, text or any other media type.

[0008] The CDF working group is currently attempting to combine separate component languages (e.g. XML-based languages, elements and attributes from separate vocabularies) such XHTML, SVG, mathematics markup language (MathML), and SMIL, with a focus on user interface markups. When combining user interface markups, specific problems must be resolved that are not addressed by the individual markups specifications, such as the propagation of events across markups, the combination of rendering or the user interaction model with a combined document. This work is divided in phases and two technical solutions: combining by reference and by inclusion.

[0009] XML based content has traditionally been transmitted over networks in three modes: (a) download & play (e.g. HTTP/TCP, MMS); (b) progressive download modes; and (c) streaming mode. In modes (a) and (b), the XML client can be assured of the completeness and integrity of the received content. Regarding mode (c), 3GPP and the Open Mobile Alliance (OMA) have recently begun work on the streaming of rich media in the PSS and MBMS frameworks. Real-time Transport Protocol (RTP) is the current, preferred protocol for streaming delivery of continuous media like audio, video, timed-text and SVG.

[0010] In enabling the streaming of XML data, an RTP payload format, a set of packetization rules, and error resiliency mechanisms need to be defined. U.S. Provisional Patent Application No. 60/713,303, filed on Sep. 1, 2005 and incorporated herein by reference in its entirety, defines an RTP payload format and some packetization rules. However, the scenario when a large XML document needs to be fragmented across multiple packets is not addressed. A simple approach to fragmenting an XML document involves chopping it into fragments that fit a transport packet size. If an XML client receives all of these fragments, reconstruction of the XML document is trivial. However, if one or more fragments are lost, reconstruction of the XML document becomes challenging, because the fragmentation does not take into account the nesting structure (syntactic property) of the XML content. Therefore, fragmentation methods that exploit the nesting structure of the XML content are needed. Also, given a particular fragmentation method, there is no existing solution as to how the information related to the fragments is signaled in the payload of the transport packet.